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Advanced Decision Analytics with Fuzzy Logic Integrating AI and Computational Thinking for Personnel Selection

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Abstract

Advanced decision analytics, fuzzy logic, artificial intelligence, and computational thinking may be used to improve personnel selection in today's dynamic industry. This research introduces a decision-support framework that uses AI approaches based on fuzzy logic to handle complicated decision-making and improve personnel selection. Hiring the right person for the job is very significant for any business. However, numerous companies have Human Resources (HR) teams that deal with this issue. This study created a staff selection method using the Fuzzy Simple Additive Weighted (FSAW) Method, which considers the applicants' personalities and the fact that people are very subjective. The study aimed to find a method to hire people using fuzzy logic. A three-level plan was made to keep track of the information. Applicants would be ranked by how well they would fit the job. Personality was the most important thing to consider. Someone best does the job with the right skills and natural traits or abilities. Finally, the study showed that the best people can be hired, leading to work success. The results show that this hybrid strategy increases the consistency of decision-making while improving the accuracy, sensitivity and fairness of personnel selection across several case scenarios.

Keywords: TOPSIS method, Multicriteria problem, Z-Number fuzzy AROMAN technique, Preliminaries, AROMAN technique.

1 | Introduction

Companies work in a rough world where things are always changing, and competition is growing worldwide. HR professionals need to think of and use HR methods that can keep companies safe from these threats [1],

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[2]. One important part of a business is human resource management or HRM. It makes decisions that affect how employees work for the company and how well the business does financially [3], [4].

To find and hire the right person, you must find and put them in the right job [5]. Xiao and Björkman [6] also said careful selection methods are important when hiring people. Interviews, tests, and work samples are just some ways job candidates are judged during the hiring process. This makes it harder for people to apply, and the chosen people may have better skills and better behaviour patterns [7]. It also says that this process should be based on the skills and abilities of the candidates rather than their experience and academic background. The candidate's social skills and attitudes should be emphasized during talks to ensure they fit in with the company's culture [8]. This process isn't just about filling open positions; it's also about getting the right people on board from the start so that the organization can benefit from their work and skills to help it reach its goals. So, a careful hiring process that looks for people whose personal and cultural values are similar to those of the organization will create a better workplace where helpful behaviour can happen more easily [9].

Pfeffer and Veiga [10] said that the following things must be true:

I. The organization needs to have a lot of people to choose from. There are more chances to find the right person when there are more choices. This large pool of prospects gives the choosing process a strong base.

II. It is necessary to have a clear picture of the most important skills and traits needed for the job. For a correct evaluation of the candidate's skills, the interview questions must cover particular situations involving these skills.

III. When people look for jobs, they should ensure that the skills and abilities they want are a good fit for the job and the company's plan in its market. This connection guarantees that the chosen people align with the organization's goals and ideals.

IV. A hiring procedure focusing on discovering people who fit well with the company's culture is more likely to work.

Making sure that the right people start in the right jobs [11] can help the company if the choosing process is well thought out and planned. This makes it harder to pick the right person for the job because changes within the company directly impact how HR picks people [12].

The literature review found a lot of different ways to hire people. Some of them are TOPSIS [13], MCDM [14], and the Ordered Weighted Average (OWA) operator. Each one uses more than one fuzzy factor to help them decide. This study didn't look into how to choose between options based on more than one thing. It can use deep learning [15], shared neural networks [16], and other data science approaches to improve these.

Choosing employees has been done in the past in a variety of ways. A real-life instance comes from research in Greece that used TOPSIS, a fuzzy multicriteria decision-making method, to hire people for a bank. It was very important to look at certain criteria, how these criteria are weighted, and how far away the anti-ideal and ideal answers are to find the best choice [12]. Another study in Iran showed that the train business doesn't have enough skilled project managers. It was decided to use multigene genetic programming regression (CSPR) as a competency-based selection method. The results were good, and they cut down on the time and money needed to complete the job [17].

Also, a study in India looked at two new ways to choose supply chain workers and compared them: AHP-LP and TOPSIS-LP. Both work well, but TOPSIS is easier to use because it only ranks applications once. AHP compares two things at a time and is more accurate because it takes regularity into account. This way, it saves money by assembling a good team for the job [18]. A different study looks at how the Ordered Weighted Average (OWA) operator can pick people to work in sports management. They learnt that the type of measure could change the choices and outcomes [19]. A study's description of a perfect candidate was also used to develop the Canós–Liern method. The total fuzzy grade for a candidate is found by adding up the numbers of all the experts. The candidates are then ranked by how much they resemble the ideal candidate [20]. In

previous research, there wasn't much that compared how different methods, like the ones used in this study, are used to evaluate different situations for placing people in a selection process.

Potential biases or inadequate assessments might result from traditional systems' inability to include subjective features like flexibility or interpersonal skills in a systematic decision-making framework. To add slightly to the grievance, no systematic weighing mechanism is currently available in this area of fuzzy logic approaches that can balance the value of different criteria. This research addresses that need by providing a structured, weighted scoring system that improves hiring choices' impartiality, consistency, and resilience through an integrated Fuzzy Simple Additive Weighted (FSAW) method.

This study develops a novel FSAW model for personnel selection, which incorporates fuzzy logic and a weighted scoring system to account for subjective and objective factors in decision-making. The technique utilizes fuzzy logic to accurately describe subjective qualities like adaptability and leadership potential, which are traditionally difficult to quantify due to their inherent ambiguity. Furthermore, the FSAW technique provides a structured and organized review procedure that strives to improve the accuracy and equity of personnel choices by integrating several factors into a single framework. This method is unique because it provides a more sophisticated and adaptable response to difficult people selection decision-making situations. Four different approaches will be used to make this happen:

I. TOPSIS: this method ranks candidates by how far they are from two ideal and anti-ideal answers. It does this by using scores and a weight vector that has already been set.

II. OWA: this method will focus on finding a candidate who performs better than competitors on a world level without focusing on a single skill.

III. Canós–liern: these steps are meant to help you find the candidate who best fits a description that the company has already set.

IV. Expert evaluation replication: someone with a lot of experience will rate the skills of a group of candidates, and a linear programming model will use that rating to make a weight vector that fits the rating for a bigger group of candidates.

The TOPSIS method evaluates possibilities according to their proximity to ideal solutions, considering the distances between the negative and positive ideal points. For decision-makers with varying levels of optimism or pessimism, OWA is a valuable tool for aggregating criteria by giving each criterion a weight according to its relative relevance. The Canos-Liern technique uses a fuzzy aggregation operator to effectively handle uncertainty in decision-making by using fuzzy logic to aggregate quantitative and qualitative inputs. In conclusion, Expert Evaluation Replication incorporates a variety of viewpoints into the decision-making process by collecting evaluations from various experts and employing consensus scores derived from standardized questionnaires. These approaches strengthen the decision-making process by including qualitative and quantitative assessment, considering subjective criteria, and dealing with inconsistency. The important goals of this article are shown below:

I. In a selection process, making a list of candidates will help you use multiple factors to choose the best ones.

II. Come up with different times and places to use each multicriteria decision-making method based on the amount of knowledge needed for each character and the company's different needs and traits.

III. It is important to show that potential evaluations are valid across all skills, as this determines the best decision.

2 | Literature Review

A lot of different MCDM methods have been written about over the years. This is a way to select the best order based on how close the answers are to the best answer that Hong and Choi [21] came up with. This program aims to discover the best options closest to the positive, perfect answer. Since it was first created, the TOPSIS method has been used by many people to make decisions. This algorithm has also been made to work in fuzzy and soft-set settings. To handle choice problems with fuzzy knowledge, Chen [22] added fuzzy

TOPSIS to the original TOPSIS. This essay talks about using language to explain criteria weighing and chance rating. Over the years, the extended fuzzy TOPSIS algorithm has been used in more fields, such as transportation, management, and Human Resources (HR).

The fuzzy TOPSIS method for getting around was created by Bottani and Rizzi [23]. Ashtiani et al. [24] created the interval-valued fuzzy TOPSIS method to solve MCDM issues with unequal criteria weights. It is based on the ideas of fuzzy TOPSIS and interval-valued fuzzy sets. Ghassemi and Danesh [25] picked a filtering method that uses fuzzy AHP and TOPSIS. The TOPSIS method was also used to pick a virtual business partner. The fuzzy method, the multicriteria TOPSIS method, and the Analytic Hierarchy Process (AHP) were all utilized by [26] to figure out the work's criteria and weights.

Gulzar et al. [27] made a new system that uses fuzzy logic. Its main goal is to connect parts of standards for usefulness to user scores. This method puts the different needs for use in order of their importance. MATLAB fuzzy logic was used to make this happen. A study by Mustafa et al. [28] displayed that the fuzzy choice method can go differently. They made a multicriteria structure model for choosing where to put a shopping centre based on how logistics work. Mathew et al. [29] discussed a new way to pick an advanced manufacturing facility using a sphere fuzzy set to mix AHP and TOPSIS. One good thing about using a soft set is that it has tools for setting up shortages. It's still not clear when to use fuzzy sets of type 1. Type-2 fuzzy set is now used to fix the issue that was brought up. Lathamaheswari et al. [30] used a soft set and a type-2 triangle interval fuzzy set to investigate it. They developed a TIT2FSWA for triangle interval type-2 fuzzy soft weighted arithmetic operators. They learnt how to make money by talking about choices in this way.

Wan et al. [31] used the imperfect interval multiplicative preference relation (IMPRS) to explain how people make decisions by adding a Fermat fuzzy soft set; Salsabeela and John [32] improved TOPSIS at MCDM. Farmers can get help from insurance plans in case of an accident, but it may be hard to pick the best plan. Chu and Le [33] devised a FAHP method to resolve this case. The score method is used to look at all the farm insurance plans and pick the best one. They proved that this way of making predictions could work by comparing numbers. Mng'ong'o et al. [34] in Sustainable Agriculture Tanzania (SAT) to rate the performance of crops and find the best ones. They believe the most important thing that needs to be done immediately to improve low-performance goods is to find ways to enhance low-weight factors.

Mahboob et al. [35] proposed a Multi-Attribute Group Decision-Making (MAGDM) for evaluating the impact of artificial intelligence on education. Through a systematic analysis of the tensions and trade-offs among several elements comprising social, ethical, pedagogical, and technological concerns, a MAGDM framework may help provide clear and reasonable suggestions for integrating AI into education. The 2-Tuple Linguistic q-Rung Orthopaedic Fuzzy Set (2TLq-ROFS) is an innovation in fuzzy set theory. It allows decision-makers to blend quantitative evaluation concepts with qualitative evaluation information, and it is also an extended variant of the previously existing flexible set. To conclude, the stated approach is supported by a case study examining artificial intelligence's effects on education. A comparative study evaluates the advantages and improvements of the technique.

Rifaqat Ali et al. [36] presented complex Fermatean fuzzy models and algebraic aggregation operators in decision-making reducing. The effects of COVID-19 have been challenging for the World Health Organization (WHO), calling for flexible and regional public health strategies. The analysis of the virus's propagation has relied heavily on traditional mathematical models, which often use real-valued classical integer-order derivatives; however, these models fail to appropriately account for the fading memory effects in such complicated situations. Fuzzy Sets (FSs) provided a strong foundation for handling the uncertainty inherent in the dynamics of the epidemic, allowing us to circumvent these shortcomings. This study presents new approaches that leverage the Complex Fermatean Fuzzy Weighted Geometric Aggregation (CFFWGA) operator, and Complex Fermatean Fuzzy Hybrid Geometric Collection (CFFFHGA), Complex Fermatean Fuzzy Ordered Weighted Geometric Aggregation (CFFOWGA) operator, operator, as well as their respective geometric aggregation operators.

Palanikumar et al. [37] suggested a Fermatean Vague Regular Set (FVNS) for different distance methods to multicriteria decision-making challenges for ranking ambiguous sets. Log Generalized Fermatean Vague Normal Weighted Averaging (log GFVNWA), log generalized Fermatean vague standard weighted geometric (log GFVNWG), logarithmic Fermatean vague standard weighted geometric (log FVNWG), and are the operators discussed in this article. The log FVNS's scoring function, accuracy function, and operating rules were described. Numerical examples are provided to expand the Euclidean and Humming distances. Additionally, attributes like boundedness, idempotency, monotonicity and commutativity of the log FVNS derived from algebraic operations are investigated. A subfield of applied engineering known as agricultural robotics has drawn parallels to CS and MT. Five types of agricultural robotics articulated, humanoid, cobot, and hybrid, are randomly selected. The results may be compared to predetermined standards to determine which robots worked best.

Qiu et al. [38] investigated a simplifying the complexity of selecting the best private-sector partner. The author gathered the decision-makers opinions using single-valued neutrosophic sets (SVNSs), which can deal with partial, ambiguous, or imprecise data. Afterwards, the author defined ideal alternatives and used the similarity measure to specify the rankings of the choices. In addition, we investigated the performance of other possibilities in four future scenarios to confront the unpredictable environment. Using a numerical instance, the stages of the suggested technique are presented. Findings showed that using a simple approach that considers the problem's complexity dimensions, even those lacking extensive operations research expertise could choose the optimal solution.

Jing et al. [39] delibrated a multicriteria decision-making method for optimal selection of stock portfolios. Using multicriteria decision-making approaches, this research examined complete modelling for the optimum assortment of stock portfolios in firms itemized on the Tehran Stock Exchanges. This study was conducted using data from 79 firms that are listed on the Tehran Stock Exchange. A total of 24 businesses were ultimately chosen after data simulations, and programming in MATLAB enabled the execution of the cumulative data analysis model. In great detail, this research examined how firms traded on the Tehran Stock Exchange may benefit from multicriteria decision-making when choosing their stock investments.

Ahmadabadi et al. [40] proposed an integrative method integrating hesitant fuzzy TOPSIS and meta-synthesis for the factors affecting supply chain resilience. The research used a systematic methodology and the meta-synthesis technique to identify the variables impacting SCR from papers indexed in scholarly databases. The five parts that subsequently constituted a model with 33 components were production and distribution management, communication and participation management, financial and information management, HR management, and risk and crisis management. The most critical factors influencing resilience in the supply chain include maintaining robust supplier relationships, employing lean production to eliminate waste, ensuring technological flexibility in production, implementing integrated information technology infrastructures, and maintaining a safe stock of materials. The novel scientific framework of elements proposed by this research via a systematic approach and identifying essential aspects generally set it apart from others in this field.

Cao et al. [41] presented a determining efficient managerial aspects in enhancing and renovating old urban tissues. In this research, the author will look at one Iranian city (Langrud) and determine the most essential management criteria for restoring older structures. In addition to being descriptive and based on contextual information, the current study has a practical goal. All six hundred and fifty employees of Langrod City's engineering system organization and the municipal government made up the population for the quantitative phase. Using Cochran's technique, we randomly assigned 335 participants to fill out the survey. Participants were given a questionnaire and a semi-structured interview to complete as part of the study. Using preexisting criteria, we established the surveys' validity and reliability. Structural equations modeling, Fuzzy Analytic Hierarchy Process (FAHP), and Factor Analysis (FA) were used to examine the data. Findings indicated that resource-related management elements and indicators were most helpful in restoring and enhancing the city's unique materials.

Nafei et al. [42] suggested Neutrosophic Triplets (NTs) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). The suggested technique suggestively improves the accuracy and computing effectiveness of the decision-making procedure by using a ranking policy based on frequency analysis and NN-driven machine learning. Due to the increasing complexity of Multi-Attribute Decision-Making (MADM) situations, where conventional approaches fail to evaluate options appropriately in the face of ambiguity, this study is necessary. The originality comes from combining NTs with a machine-learning strategy, which makes MADM's architecture more adaptable and strong. Green supplier selection is an integral part of sustainable supply chain management, and the suggested technique shows how it may help in this area.

Venugopal et al. [43] discussed a Fuzzy Inference System (FIS) for improving daily stock trading with a new fuzzy indicator. Following a component of the FIS takes the fuzzed numbers as input and produces signals telling you whether to buy, hold, or sell stocks. To confirm the significance of the FIS, experiments are conducted using a meticulously chosen set of NASDAQ equities. As alternatives, we may look at technical indicators; as criteria, we can use fuzzy risk-adjusted returns to demonstrate the FIS's efficacy. A new Z-number-based TOPSIS technique ranks the technical and FIS indicators. The comparison outcomes show that the created FIS outperforms the current indicators and produces better profits.

Fasihi [44] recommended a multi-criteria analysis methods to assist decision-making in renewable energy supply chains. Provided into the FIS, the fuzzified data then provides signals suggesting the best action, whether buying, holding, or selling stocks. The author conducts experiments using a hand-picked set of NASDAQ equities to prove that the FIS is essential. Technical indicators are seen as a potential alternative, whereas fuzzy risk-adjusted returns are seen as a criterion to demonstrate the FIS's efficacy. The technical indicators and FIS are ranked using a new Z-number-based TOPSIS algorithm. The created FIS outperforms current indicators and produces better returns, as the comparing findings show.

Fahimi et al. [45] suggested a performance assessment model for the Tehran municipality utilizing TOPSIS and AHP. The suggested approach comprises team building, process identification, vision consideration, weight calculation, indicator selection, data collection, data extract-transform-load, data warehousing, reporting, analysis feedback, and enhancement procedures. The weight calculations and ranking of the cities are done using the AHP and TOPSIS. Moreover, the author normalizes the data using the Simple Weighted Mean approach in four distinct methods. Then, the author compares the findings and utilizes criteria to pick a robust solution. There is a comparison between the Balanced Scorecard and the model developed by the European Foundations for Quality Management.

Wanke et al. [46] discussed an Multiple-Criteria Decision Making (MCDM) for Decomposition into Latent Vagueness and Randomness Elements. TOPSIS and Complex Proportional Assessment (COPRAS) are used to calculate partial distances and partial utility functions, respectively. The second step is to separate uncertainty components from the unbiased performance scores using the Latent Vagueness and Randomness Components (LAVRA) approach. Third, drivers of lockdowns are categorized using performance, fatalities, and areas using a bootstrapped neural network regression. The availability of ventilated beds is a crucial motivator, but staff absenteeism from COVID-19 and a high admission rate of senior inpatients are less significant. According to the data, TOPSIS yields performance scores between 0.65 and 0.75. However, COPRAS analysis considerably lowers the ratings.

Keyser and Pooyan [47] developed an application of the 5 Whys and Lean Process Failure Mode and Effects Analysis (PFMEA) for Home Projects. Despite their common usage in business, root cause analysis methods might be just as helpful for DIY tasks around the house. In this study, we look at two examples of home improvement projects that use root cause analysis: 1) a 5 Whys analysis of a home AC unit that runs constantly without temperature, and 2) a novel Lean PFMEA for fixing a John Deere riding mower that suddenly stops working. Using the 5 Whys approach, a mistake in the original AC unit's colour-coded wiring to the thermostat was uncovered. As a result of a Kaizen event and the accurate diagnosis made possible by lean PFMEA, the mower's start/stop problem was resolved by cleaning the gasoline tank and repairing the fuel filter, fuel lines, and carburettor.

Ghasem Abadi [48] suggested machine learning techniques for comprehensive analysis. This study explores machine learning methods to detect and categorize counterfeit money. Applying various classification techniques, the research builds a strong model for automated detection using a dataset that includes real and fake banknotes. Essential properties like texture, colour distribution, and security attributes are retrieved to train the model, allowing for a comprehensive examination of note authenticity. The suggested approach shows great promise in identifying real money from imitations, improving safety measures for financial transactions and reducing economic corruption.

Ikpe and Ekanema [49] presented an Open Shortest Path First (OSPF) and Enhanced Interior Gateway Routing Protocol (EIGRP) routing protocol for Engineering wired network performance enhancement. Transferring transmissions from the EIGRP domain to the OSPF domain and back was done using the default and customized parameters. Findings showed that decreasing timer settings significantly lowered packet losses, improved network stability, and accelerated convergence time for packets passing from OSPF to EIGRP domains and back again. Timely delivery of packets was ensured by observing shorter pathways to the destination. Insights about how to make many routing protocols work more effectively as one unit is found in the research. Network managers and engineers need strong knowledge of route redistribution techniques to handle many protocols efficiently.

Navabakhsh and Shahsavari Pour [50] discussed Data Envelopment Analysis (DEA), which calculates the performance of social institutions. Two-level DEA classifies the inputs and outputs to quantify their efficiency and uses standard weights when there are comparable inputs and outputs. Primitive social institutions often have simple and restricted social system inputs. However, the input is varied and enhanced in complex, standardized systems. Consequently, this study has tried to use BSC to create performance evaluation indices and two-level DEA for monitoring.

Dulal et al. [51] recommended a Covid-19 pandemic data analysis using tensor methods. The author predicts the spread of COVID-19 instances and identifies hotspots using a regularized iterative tensor completion approach and a feasible regularization parameter estimator. Our approach on a weekly and quarterly basis may accurately predict Covid-19 spreads. Finally, we look at US-based COVID-19 data using an innovative sampling strategy based on alternating least squares. We also compare the techniques to typical tensor decompositions regarding interpretability, visualization, and cost analysis. Ultimately, the author uses the New Jersey COVID-19 case tensor data to show that the strategies work.

Table 1 shows an overview of the literature study. It shows the following research holes.

Table 1. Summary of literature survey.

Study	Publication Year	Technique	Limitation (s)
[23]	2006	Fuzzy TOPSIS method for logistic services	The selection tree needs to be established into a multi-tier hierarchy to address the upper and lower-tier relationships.
[24]	2009	Interval-valued fuzzy TOPSIS method	The suggested MCDM employs inadequate weights. This could present bias or skew the outcomes.
[25]	2013	Fuzzy AHP and TOPSIS methods	Inefficient MCDM procedure caused by ambiguity because of enlarged sample size
[26]	2015	Type-2 soft sets	Association among decision-making features is not measured
[27]	2017	A new framework using fuzzy logic concentrating on mapping features of usability necessities	Lack of standards for the prioritization of contradictory usability necessities characteristics

I. No clear standards are used to compare the decision-making tools, leading to disagreements and wrong conclusions.

II. The multicriteria decision-making problem from an earlier study said that the chosen factors could differ. This makes the sample number bigger, which adds to the question.

III. In the decision-making problem, objective and subjective approaches are used to deal with doubts in weight-gaining decisions. Euclidean distances keep the judgement consistent without considering how the qualities relate. The Euclidean distance isn't perfect because it assumes that the sample centres are spread out in a circle around the sample mean.

The insecticide choice problem could be solved with FMCDM with type-2 soft sets and TOPSIS. This is detailed in Section 3. This would help get more accuracy and choice in decision-making. The model came up with is Multi Fuzzy TOPSIS because it uses fuzzy logic and TOPS to help people make decisions when the information or their opinions aren't unclear. The TOPSIS method lets you pick an order based on how close it is to the best answer. With fuzzy type-2 soft sets, the MultiFuzzTOPS model tries to make it easy to decide what to do when confusing and unclear. This is a list of symbols used often and what they mean (*Table 2*).

Table 2. Acronyms and their descriptions.

Acronym	Description
$ajaj$	Attributes of primary parameters
$cjcj$	Attributes of underlying variables in type-2 soft set $(F,A)(F,A)$
$didi$	Attributes of underlying variables in type-2 soft set $(G,B)(G,B)$
$S1S1$	Triazoles spray
$S2S2$	Strobilurin spray
$S3S3$	Mancozeb spray
$S4S4$	Propiconazole spray

3 | Preliminaries

This part is broken up into general thoughts and a study of the most recent writings in the field so that new readers and professionals can understand it.

3.1 | Preliminaries

If you're new to this subject [52], this part covers some important broad ideas. It discusses soft sets, type-2 soft sets, and the TOPSIS method.

3.1.1 | TOPSIS method

Hwang et al. [13] discussed how the TOPSIS method ranks options to help people make different decisions. The person who makes the choice breaks down the criteria into things that help them choose. The tool uses the Euclidean distance method to find the best choice, the farthest from the Negative Ideal Solution (NIS) and the Positive Ideal Solution (PIS). If you said "yes," then the value and cost needs are met. Each answer is ranked by how close it is to the best answer.

3.1.2 | Soft Sets

Molodtsov [53] says that a pair (F, E) is only a soft set over U if F maps E into the set of all U's subsets, that is, I:g→$M(U)$I:$E\rightarrow M(U)$, where $M(U)$ is U's power set and E is a set of parameters. Sets I(ϵ),□ ∈C and J(ϵ),□ ∈C are in this family. You can think of each set as a part of the soft set (I,g) or a ∈-part of the soft set. This case shows how the idea above works.

Example 1. Molodtsov said that A is the map and U is the set of shoes being looked at. There are five sets of shoes in this world, which can be seen by U={U={Set of Shoes}={$e^{1,}e$2,e3,e4,e5}}={e1,e2,e3,e4,e5} and D={D={Color, Comfortable, Cheap, Durable}={1, 2, `3, `4}}={1, 2, `^3, `4}.

Mr. Ali wants [1, 2] [Colour, Comfort] shoes. Think about what would happen if E KE K:

y:**g** → (**I**):**A** → (U), which is shown by

$F(e1)=F(colTur)=\{y1,y2\}$, $F(e1)=F$(color)$=\{y1,y2\}$,

❒ (宏2)=**J**(comfortable)$=\{y1,y2,y3\}$, $F(e2)=F$(comfortable),

The soft sets (**I**,)(**I**,**A**) can be thought of as the following set of close estimates:

$(F,E)=\{(colour,\{y1,y2\}),(comfortable,\{y1,y2,y3\})$.

3.1.3 | Materials and methods

Fuzzy Simple Additive Weighting (FSAW) was used in this study. It's also known as the score or weighted linear combination method. This is a simple and popular way to pick something based on multiple traits.

People say that interviews, personality tests, intelligence tests, and Computer-Based Tests (CBT) can all be used to choose employees. The flexible employee choice method uses four factors to decide whether a candidate fits the job.

Two language variables describe an applicant's temperament: suitable and inappropriate. A language ability test measure comprises three words: above average, normal, and below average. There are three speaking skill levels on the Computer Base Test: above average, average, and below average. Three things make an interview. For example, the amount of trust, words used, and calmness.

A new framework will be shown to help people in charge choose the best employees from the large group of applicants. The system compares job requirements with candidate records to make a short list of applicants. It then notifies those applicants that they have been chosen to move on to the ability test and interview. The fuzzy engine then uses the applicants' scores to rank them. The following method is used in this study:

I. The human resource manager spells out all the requirements for each job opening.

II. The open positions in the company will be published so that people can apply.

III. The people who want the job apply for it. Applicants are put on a shortlist and notified by email and text when a match is found.

IV. Those who made the shortlist must take intelligence, computer-based, and attitude tests.

V. The interview groups talk to the people who have applied; vi. Fuzzy Simple Additive Weighting (FSAW) determines the applicants' scores, which are then sorted based on a fit check.

A case study to demonstrate the algorithm is accessible. Becoming the IT Manager of a large company's ICT area is possible. Using a fuzzy relational database, candidates are whittled down based on their gender, age, qualifications, skills needed, and work experience.

When they hire someone for the first time, HR determines what personality type will do the job best and gives that personality type a fuzzy weight. People were put into four groups based on the traits they had. People in these states were called choleric, sanguine, sad, and phlegmatic. When someone takes the temperament test, they can choose from a list of words to find the ones that best describe them. There are twenty-five words to describe each of the four temperament groups. This means that 20 buzzwords are mixed up randomly in the test of personality and fitness. The person applying should pick the keywords that best describe them, even if they don't know what kind of person they are. These keywords are picked out by the system and matched to the personality type that HR sets. It then gives the overall number of keywords a "fuzzy" score used to judge them further. The candidate only checks four keywords for Melancholy and four of the total number of keywords allocated for cheerful. This means that HR sets the character suitability level to Melancholy. The system will understand that the individual is cheerful based on how much weight is given to each term in each field.

The fuzzy values shown in the table are used to decide if a candidate is a good fit.4.The HR staff figures out what kind of personality is best for the job and assigns it during the first round of hiring (*Table 3*).

Table 3. Temperament suitability test.

Attributes	Fuzzy Weight	Fuzzy Score
Suitable		W61 - 0.07
Unsuitable	W6 (0.2)	W62 - 0.03

As part of the hiring process, HR decides what kind of personality is best for each job opening and assigns it to the candidate. There are four mood groups for all of the traits: depressed, choleric, sanguine, and phlegmatic.

The weights can be changed to fit any character test. These weights are changeable and can be changed based on how important the computer skills test is for a job search.

The CBT is based on fuzzy scores of the traits, and the test is worth sixty points. People whose scores are in the given range get a " fuzzy " number in that area. The fuzzy best point is 1, but the fuzzy weight W5 (0.15) is not even close. W51, W52, and W53 are all soft weights that add up to W5 (CBT). These weights take into account all the different kinds of computer tests. These tests can be changed based on how important computer skills tests are for a job search (*Table 4*).

Table 4. Computer based test.

Attributes	Average Range	Fuzzy Weight	Fuzzy Score
Above average	45 – 60		W51 - 0.07
Average	34 – 44	W5 (0.15)	W52 - 0.05
Below average	Below 34		W53 - 0.03

3.2 | Calculation and Applicants Ranking

We will use the next case to show how the program works based on age, gender, skills needed, and work experience.

Job title: someone between the ages of 25 and 40 who runs a network.

Education: it is best to have at least a bachelor's degree and CCNA certification.

Work experience: longer than two years.

Sex: one or both men and women.

Skills required: marketing, adapting, team type, emerging, having an impact, and expressing oneself.

The HR manager decides the exact requirements that meet the job requirements based on the above points. The following are given high fuzzy marks to choose people who meet the below requirements.

3.3 | Evaluations

To determine how many points each candidate got, use the facts in *Table 4* and the method below. The fuzzy weights increase the fuzzy score given by

$$\sum n = (\text{general point} * \text{range point}). \quad (1)$$

Grades for the applicant (A1)

$= (0.2 \times 0.03) + (0.1 \times 0.04) + (0.1 \times 0.04) + (0.15 \times 0.05) + (0.15 \times 0.05) + (0.1 \times 0.04) + (0.2 \times 0.03)$

$= 0.006 + 0.004 + 0.004 + 0.0075 + 0.0075 + 0.004 + 0.003 + 0.006$

$= 0.042$

Applicant (A2) grades

= (0.2 × 0.04) + (0.1 × 0.04) + (0.1 × 0.04) + (0.15 × 0.03) + (0.15 × 0.03) + (0.1× 0.04) + (0.2×0.07)

= 0.008+ 0.004+ 0.004+ 0.0045 + 0.0045 + 0.004 + 0.014

= 0.043

Grades for the applicant (A3)

= (0.2 × 0.13) + (0.1× 0.06) + (0.1 × 0.06) + (0.15 × 0.07) + (0.15× 0.07) + (0.1 × 0.06) + (0.2×0.07)

= 0.026 + 0.006 + 0.006 + 0.0105 + 0.0105 + 0.006 + 0.014

= 0.073

3.4 | Implementation and Calculation of Weights

Some assessment with the main and secondary criteria is utilized here, and the managers give each candidate a score between 0 and 100 for how well they meet each criterion. This should add up to 100. You can see the criteria, their related sub-criteria objects, and the average scores for each in the table below:

Table 5. Related sub-criteria objects, and the average scores.

Criteria	Criteria Mean Score	Sub-Criteria	Subcriteria Mean Score
Human skills and Qualifications	45	Communication skills	22
		Creativity and novelty perspective	25
		Leadership abilities and team spirit	23
		Motivational ability	30
		Total	100

For every of the sub-criteria, such as "human skills and qualifications," "personnel information," and "general skills," the mean scores in the Table above could be used to find the weight matrices A1, A2, and A3. The names of these weight matrices are:

A1=(0,22 0,25 0,23 0,30).

A2=(0,28 0,22 0,25 0,25).

A3=(0,24 0,26 0,23 0,27).

Likewise, the following steps are used to get the generalized weight matrices A from the criteria mean score:

A=(0,45 0,35 0,20).

It was thought there would be a five-person party group to get the data for the second step. Members were asked to rate the candidates' looks on a scale from 1 to 5, with 5 meaning "Very High," 4 meaning "High," 3 meaning "Low," and 2 meaning "Very Low." So, these conversations with candidates are used to make the matrices. To judge the results, find the union of these matrices. It's important to remember that the user-set amount in this app is not a hard and fast number. The number used in this study was chosen randomly and might differ in other studies of the same type.

3.5 | Case Study and Results

The University of Pardubice is considered as an example. There are four subsections in this part. The first one has to do with describing the case study that was looked at. After that, risk analysis is done in the third part. Finally, in the fourth part, a comparison study is done.

3.5.1|Description of considered multicriteria problem

Our goal is to find a better way to hire people and choose the best PhD person who wants to work as a transport engineer at the University of Pardubice in the Czech Republic. The first thing we'll talk about is the higher education system in this case.

Some parts of higher education in the Czech Republic have been around since the 1400s. Its name is now Charles University.

The University of Pardubice is a well-known college and university in Pardubice in the Czech Republic. It's right here (*Fig. 1*). It began as a college for chemical engineering in 1950 because making chemicals is so important to the area. It has become a big university with many schools and fields of study.

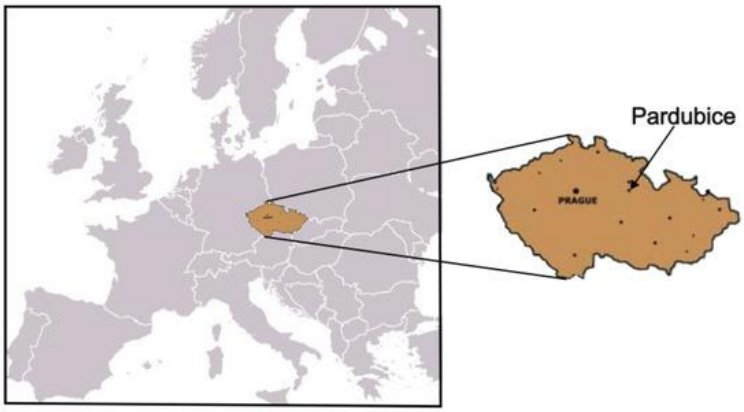

Fig. 1. Position of the czech republic and pardubice city.

People study science, management, and transportation systems in the Faculty of Transport Engineering at the University of Pardubice. This school is known for teaching all kinds of transportation, including train, road, air, and water, and how these different types of transportation work together in multimodal systems.

People in college, higher school, or the workforce should take these classes to learn the information and skills they need to work in the transportation business. The studies often look at transportation infrastructure, car engineering, safety, operations, traffic models and management, and how transportation affects the environment. Research is one of the most important things that the staff does. It has become a place where new ideas in travel technology and processes are born. The school studies several important areas, including designing and maintaining transportation infrastructure, developing smart transportation systems, analyzing safety, and making transportation more sustainable.

94 teaching staff and 4 research staff work for the Faculty of Transport Engineering. Eight hundred and twenty students are working on their bachelor's, master's, or graduate degrees. Some work full-time, while others work part-time. These fields have 615 full-time students and 255 part-time students. Ninety of the master's students are full-time, and one hundred work full-time. Twenty people are full-time candidates for the PhD, and another twenty are part-time candidates in *Fig. 2*.

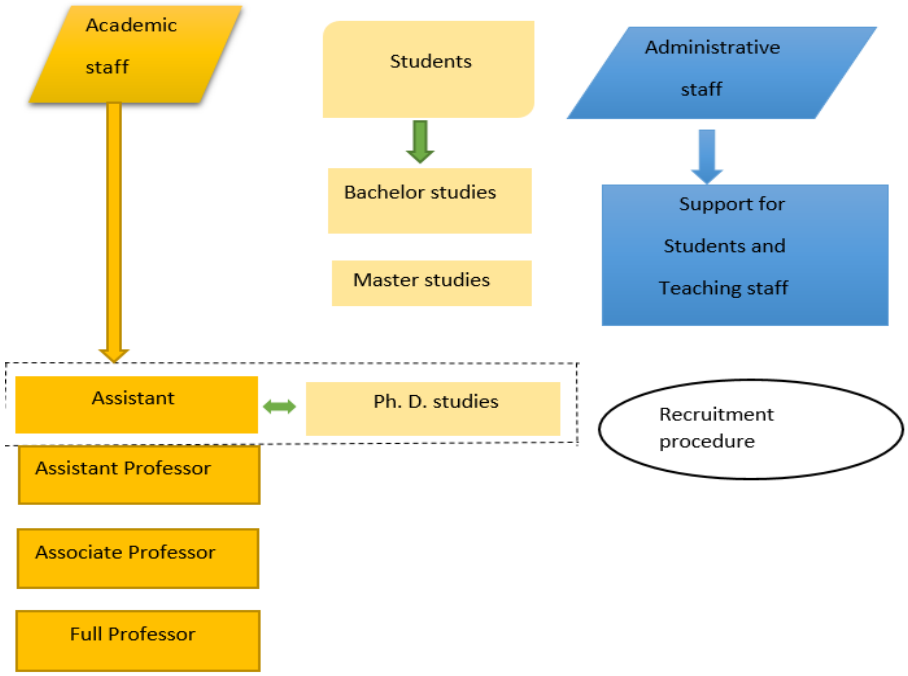

Fig. 2. Transport engineering considers employees through the organization of the faculty.

Getting young teachers is something every school that wants to grow has to do. This was a reason to show how this case study could use the given method. Person to join the school. Four of the applicants were picked as the best during the fight. MCDM comes up a lot because there are many ways to rate the prospects. The AROMAN method or its fuzzy Z-number extension is another new MCDM method that will be utilized in this case. For instance, Z-number fuzzy sets can show how people think about what to do before deciding. Combining linear and vector normalization techniques, this method gets an accurate data structure that can then be used to rank the options. To get chosen, they look at how long it took you to finish previous levels of schooling, how well you can move around, how well you speak a foreign language, how well you can use computers, and how well you can talk to people and give speeches. In *Fig. 3*, there is a picture that shows how the problem is explained.

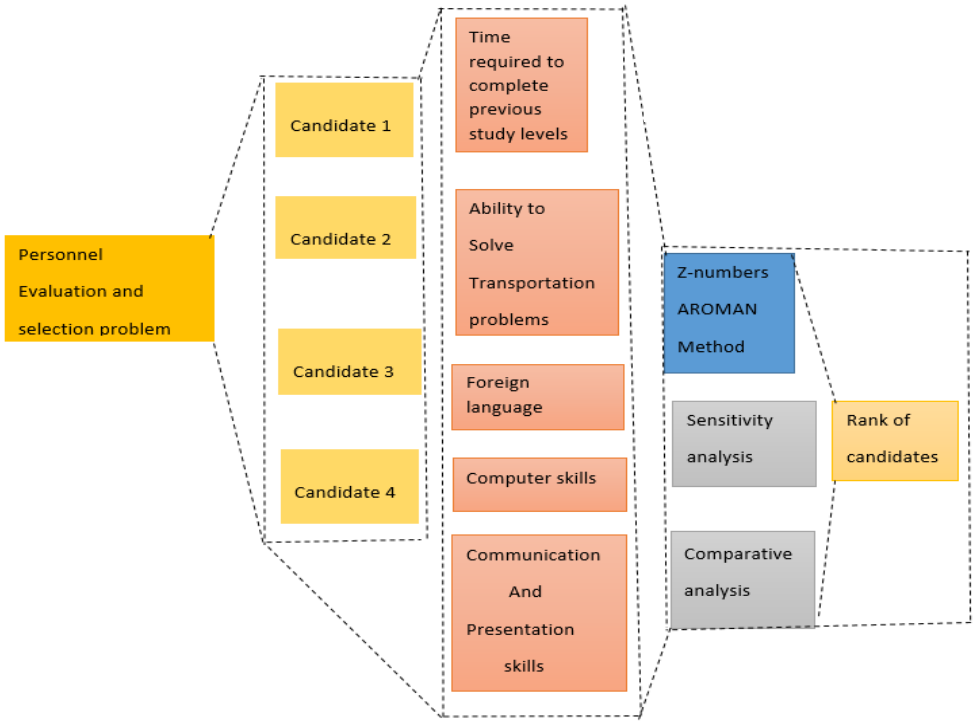

Fig. 3. Configuration of the research.

4|Results and Discussion

4.1|Z-Number Fuzzy AROMAN Technique

You could pick someone who did well on the test and got an A1, A2, A3, or A4 grade. Things that are written as C1, C2, C3, C4, and C5 make up the score.

They used the Z-numbers fuzzy AROMAN method to figure it out. MS Excel was used to figure out what was wrong.

Step 1. Language experts use language terms to rate the choices. Their results were used to make the first decision-making grid in *Table 6*. Three UPCE experts worked together to get the information in this case. But remember that these experts didn't give data for all criteria; they only gave data for criteria that were part of their job. Most of the time, experts in the field of MCDM give answers for all categories. This method is a little different from that. On the other hand, the people who wrote this paper thought that it would be better and more fair to give each expert a different set of standards to work on.

Table 6. An initial decision-making matrix.

	C1	C2	C3	C4	C5
A1	(MH, AR)	(ML, MR)	(VL, AR)	(ML, SR)	(ML, VSR)
A2	(H, VSR)	(M, SR)	(ML, AR)	(M, WR)	(MH, VWR)
A3	(VH, SR)	(ML, VSR)	(VL, SR)	(M, AR)	(M, MR)
A4	(MH, MR)	(MH, SR)	(L, AR)	(MH, SR)	(M, SR)

The first expert had to give answers about all the candidates based on two factors: the amount of time needed to finish earlier levels of study and the candidates' speech and presentation abilities. The experts gathered public information about the prospects and data they got from talking to them. The candidates didn't speak English as their first language, but the speeches were in English.

Step 2. *Eq. (1)* is used to get the weighted combined normalized Z-numbers fuzzy decision matrix. But first, we need to determine how much each criterion is worth. There are several different ways to do this. Subjective, objective, and combinative are the three main types of these methods that have been written about. A subjective method was used in this paper. This means that the weights we got came from what experts said. Two experts helped figure out how to judge the factors. They used a number to scale things. A certain percentage is given to each measure to judge it. They must all add up to 100% when you add them all up. The case study was about UPCE, which is how they got their jobs. Expert 1 has worked in the field for over six years, and Expert 2 has been a worker for around twenty years. Experts say that the third point is the most important. After that are criteria C4, C2, C5, and C1. *Table 6* shows the findings.

Table 7. The weights of the criteria.

Criteria	Expert 1 (%)	Expert 2 (%)	Average (%)	Weights
C1	10	10	10	0.10
C2	15	25	20	0.20
C3	40	20	30	0.30
C4	25	25	25	0.25
C5	10	20	15	0.15
Sum	100	100	100	1

4.2 | Sensistivity Analysis

The Z-numbers fuzzy AROMAN technique is tested to see if it is steady and sensitive with a sensitivity study. Things like and are changed so that the method can do its maths. This method for Z-numbers fuzzy AROMAN was run again after these parameters' values were changed. In all other cases, an increased number of 0.1 was used to test the model. First, the measure β is slowly changed by 0.1 to see how different kinds of normalization affect the end list of options. *Fig. 4* shows the results that were found.

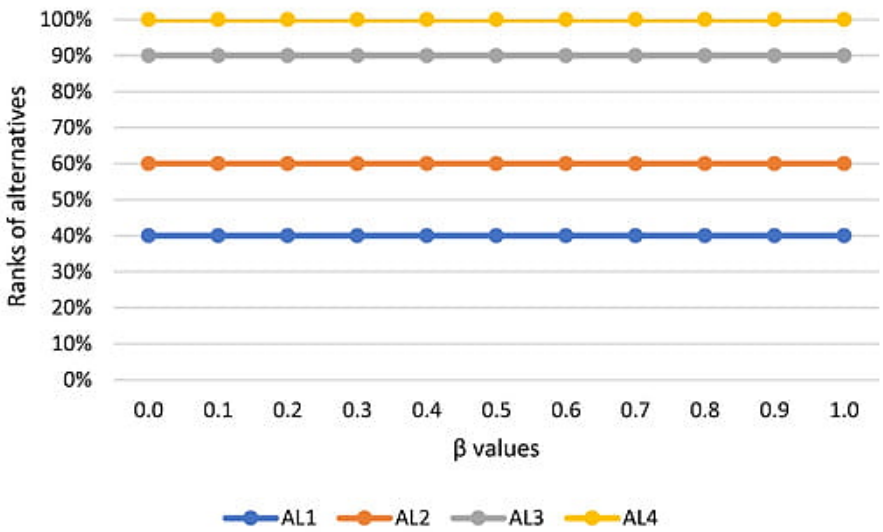

Fig. 4. Ranks of the alternatives based on the β value variations.

4.3 | Sensitivity Analysis

We didn't change the weights of the other factors. We did it this way to see how the weights of the different factors changed the score for the provider. Nine points changed the weights for each of the 144 times this was done. Because of them, we can say the following: 1) the Fuzzy TOPSIS method rates workers in various ways depending on how important each factor is. Because of this, it is very important to get the weights of each trait right. Changing the weights of the factors doesn't make a big difference in the Fuzzy SAW method. For the things that don't matter as much, this is true. It's best to use this method when it's unclear how important each reason is, and 2) The range of numbers for Fuzzy TOPSIS is almost twice as big as those for Fuzzy SAW in *Figs. 5* and *6*.

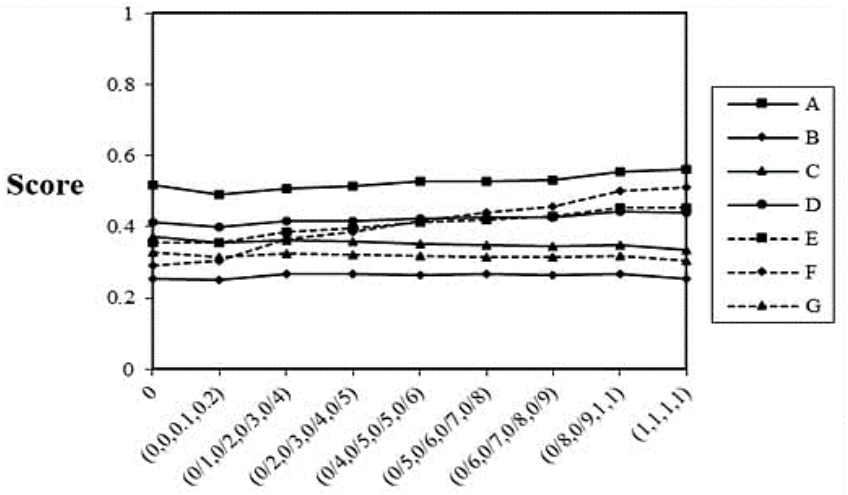

Fig. 5. Fuzzy SAW sensitivity analysis—experience criterion.

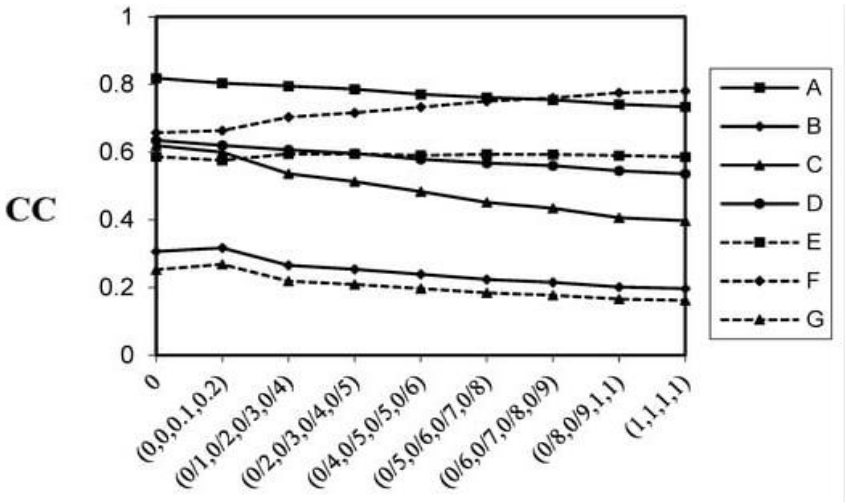

Fig. 6. Fuzzy TOPSIS sensitivity analysis—experience criterion.

4.4 | Discussion and Limitations

Evaluating potential such as communication skills, flexibility, and leadership potential may be challenging due to the inherent subjectivity involved. These traits are not simply measurable and need a combination of subjective and objective criteria. Integrating fuzzy logic into FSAW adds another layer of complexity since optimizing membership functions and thresholds for quantitative and qualitative criteria may be challenging. Further, the approach has to handle the possibility of inadequate or unclear candidate data, which may make decisions more difficult and affect the reliability of the selection results as an entire.

Few studies in social work look at how the interval type 2 DANP method can be utilized with oval-shaped fuzzy numbers. There will be more books, and this study will fill in the gaps between research. It is very important and weighty in business and management to follow through with decision-making processes. In the digital age, decision-making tools help business processes move forward. When hiring people, fuzzy MCDM techniques can help find the best option. This is just one of many ways these techniques improve business processes.

The main goals of type-2 fuzzy systems are to describe doubt and lessen its effects in systems that use fuzzy logic rules. Also, IT2 fuzzy systems are better than normal T2 fuzzy systems because they are easily understood and need less work. That's why IT2 FSs were selected for this job. Looking at the right written data, you can see that population selection doesn't use type 2 fuzzy number methods very often. The investigations are mostly about the studies that fixed the hiring problems discussed in the books using MCDM methods and T1 and T2 fuzzy numbers. This work aimed to determine if IT2 FSs could be used more broadly to deal with this doubt. The IT2 fuzzy DANP method has not been used in a hiring study. However, it has been used as a mixed method. A square matrix is what you need to give the DANP method to create a standardized direct relation matrix for pairwise comparison matrices of subcriteria choices. To finish the pairwise comparison matrices for choices and subcriteria, you need to use both a square matrix and an identity matrix for the DANP method to work. There must be the same amount of options and subcriteria. In daily English, this means that issues are more likely to happen when there are different numbers of subcriteria and options. This method worked fine because the study's factors were the same.

The IT2 DANP method spells out both standards and options for business growth. Along with that, the method includes picking the best option. Businesses can figure out which factors are important for growth in this age of digital technology by using this approach. Most research on choosing people tries to find the option that will produce the best outcome. On the other hand, this study's results show the best way to hire people for business growth and the best way to do it.

When you use this method to hire people for business growth, you can quickly and correctly find and pick the best criteria and choices. That way, you can figure out which parts are the most important. Not much work needs to be done if you look at what's already been done. Sensitivity analysis is part of this. This study's look at risks can be used as a model for other research projects in the future. An organization's process of choosing its staff is very important because the benefits of making the right choices are great, but the costs of making the wrong choices are also high. Because of this, living with it is very hard.

Benefits can be lost from bad choices about hiring people, which shows how important it is to be accurate in this area. The organization may face big problems in the future because of hiring choices that involve people who aren't completely right for the job. A sensitivity analysis is the last step in the process. It checks how constant the criterion weights are. Researchers often use sensitivity analysis to determine how long an answer will last and how well it will handle changes. Each case of the replacement order constantly shows a high level of stability. As these events show, the IT2 fuzzy DANP method speeds up the scoring process. The study also shows how important it is to do sensitivity analysis after deciding how to make decisions for the growth of a business. It could lose a lot of money if the organization chooses the wrong person for staffing, promotions, boss, or team leader positions. This is why sensitivity analysis in the study worked well.

5 | Conclusion

Fuzzy reasoning has been suggested as a new way to judge how well job applicants fit the job requirements generally. The fuzzy method gives a good reason for judging applications by carefully picking weights for skills and jobs before the applications are looked at. The HRM fuzzy logic model keeps people from making subjective value judgements during hiring and selection. It is possible to improve the method by adding more factors besides those that directly affect the HRM decision-making process. The model made for this study is flawed: it requires square matrices to create a standardized direct relation matrix utilizing the DANP method for pairwise comparison matrix of subcriteria choices. A pairwise matrix compares options and subcriteria with the DANP technique. This is because the method needs an identity matrix and square matrices. There must be the same number of choices as sub-criteria. Sometimes, the model can't work because the subcriteria and the choice don't have the same value. We might get around the fact that the DANP method needs a square grid if we do more research using fuzzy logic in the future. It would be a good move to do this. There is also software that can easily get around the issues with this method. Using complicated software could make it much easier to solve problems when hiring people for business and management assignments.

Author Contribution

Arasu Raman: Methodology, Data collection and analysis, Writing–original draft.

Mudiarasan Kuppusamy: Conceptualization, Supervision, Writing–review & editing, Project administration.

Benjamin Chan Yin Fah: Methodology, Data interpretation, Writing–review & editing.

Behrang Samadi: Data collection, Analysis.

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Data Availability

No data is generated during this research.

Conflicts of Interest

The authors declare no conflict of interest.

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